# INDIANA UNIVERSITY

TRANSPORTATION RESEARCH CENTER

# ON-SITE AMBULANCE CRASH INVESTIGATION

CASE NUMBER - IN11024
LOCATION - MISSOURI
VEHICLE - 1996 FORD E350 TYPE III AMBULANCE
CRASH DATE - July 2011

Submitted:

February 6, 2012


Contract Number: DTNH22-07-C-00044

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

**Technical Report Documentation Page**

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16. *Abstract*

This on-site investigation focused on the damage sustained by a 1996 Ford E350 Type III ambulance and the sources of injuries to the occupants of the ambulance. This crash was an offset frontal impact, which occurred on a rural, 2-lane highway. The ambulance was equipped with a Type III patient compartment and was not equipped with frontal air bags. The ambulance was operating with emergency lights and siren activated at the time of the crash. A restrained 48-year-old male driver, an unrestrained 47-year-old female Paramedic (PM), and an unrestrained 35-year-old male PM occupied the ambulance. Both PMs were located in the patient compartment attending to a 67-year-old male patient who was restrained on Ferno 93ES Squadmate patient cot. The patient was suffering from chronic obstructive pulmonary disease and myocardial infarction. He was on a cardiac monitor and receiving oxygen. The ambulance was traveling east. An unloaded 1995 Peterbilt 378 dump truck was traveling west and came upon a line of traffic that was slowing and stopping for the ambulance. The Peterbilt's unrestrained 74-year-old male driver applied lock-wheel braking and the Peterbilt rotated counterclockwise and entered the ambulance's travel lane. The ambulance's driver steered right and applied lock-wheel braking in an attempt to avoid the crash. The front plane of the Peterbilt impacted the front plane of the ambulance (event 1). The ambulance then departed the roadway and entered the right ditch. The right plane impacted an embankment (event 2). The ambulance came to final rest in the ditch heading southeast. The Peterbilt came to final rest in the middle of the roadway heading southeast. The driver of the ambulance and both PMs were transported by air ambulance to a trauma center. The driver sustained serious injuries and was admitted. The male PM sustained moderate injuries and was admitted to the trauma center. The female PM sustained moderate injuries and was treated in the emergency room and released. The patient was pronounced deceased at the crash scene.

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## BACKGROUND

This on-site investigation focused on the damage sustained by a 1996 Ford E350 Type III ambulance (**Figure 1**) and on the sources of injuries to the occupants of the ambulance. This investigation was initiated by the National Highway Traffic Safety Administration (NHTSA) on July 15, 2011 through NHTSA's Office of Emergency Medical Services (OEMS). This investigation was assigned on July 29, 2011. The crash involved the ambulance and a 1995 Peterbilt 378 dump truck. The crash occurred in July, 2011 at 1320 hours, in Missouri and was investigated by the highway patrol. The ambulance and crash scene were inspected on August 1-2, 2011. The director of operations of the ambulance company and a risk management representative were interviewed on August 10, 2011. The investigating police officer was interviewed on August 11, 2011. An exemplar Ford E350 was inspected on September 12, 2011. An interview with the driver of the ambulance was not allowed due to impending civil litigation. The police reconstruction officer was interviewed on February 2, 2012.


**Figure 1:** The damaged 1996 Ford E350 Type III ambulance

This crash was an offset frontal impact, which occurred on a rural, 2-lane highway. The ambulance was equipped with a Type III patient compartment and was not equipped with frontal air bags. The ambulance was operating with emergency lights and siren activated. A restrained 48-year-old male driver, an unrestrained 47-year-old female Paramedic (PM), and an unrestrained 35-year-old male PM occupied the ambulance. Both PMs were located in the patient compartment attending to a 67-year-old male patient who was restrained on Ferno 93ES Squadmate patient cot. The patient was suffering from chronic obstructive pulmonary disease and myocardial infarction. He was on a cardiac monitor and receiving oxygen. The crash occurred approximately 13 kilometer (8 miles) from the hospital destination. The driver of the ambulance and both PMs were transported by air ambulance to a trauma center. The driver sustained serious injuries and was admitted. The male PM sustained moderate injuries and was admitted to the trauma center. The female PM sustained moderate injuries and was treated in the emergency room and released. The patient was pronounced deceased at the crash scene. It is not known if he succumbed to his medical condition or injuries sustained in the crash since no autopsy was conducted. The Peterbilt was a 6x4 dump truck that was occupied by a an unrestrained 74-year-old male driver. The

vehicle was not loaded at the time of the crash. The Peterbilt's driver was transported by air ambulance to a trauma center and admitted.

The ambulance service provided non-emergency transfer and 9-1-1 service to a single Missouri county of 1,310 square kilometers (506 square miles) and a population density of 16 people/square mile. The ambulance service had a fleet of four ambulances and was operated by a regional health network that provided contract ambulance service to the county. The health network provided its drivers with an ambulance driver training program that was based on the Emergency Vehicle Operators Course (EVOC) and material by the National Academy for Professional Driving (NAPD).

The driver of the ambulance was an Emergency Medical Technician (EMT) and full-time employee of the ambulance service. He also was a volunteer fireman with approximately 25 years of experience. He had been an employee of the ambulance service for approximately 18 months and had previous emergency vehicle driving experience through his service as a volunteer fireman. He had completed the ambulance driver training course provided by the ambulance service. The driver was on a 24-hour rotating shift and began work at 0700 hours the day of the crash.

The female PM was seated in the single inward facing seat on the left side of the patient compartment. She was a full-time employee and had worked for the ambulance service for 17 years. She began work at 0700 hours on the day of the crash and worked a 24 hour rotating shift. The male PM had just moved from the rear-facing seat located behind the driver to the bench seat on the right side of the patient compartment when the crash occurred. He had been hired 18 days prior to the crash and was in the orientation phase of his employment. He had been a PM for over 12 years. He worked a rotating 24-hour shift and began work at 0700 hours the day of the crash.

## CRASH SUMMARY

***Crash Site:*** This crash occurred during daytime hours and clear weather conditions. The trafficway that both vehicle's were traveling on was a 2-lane, undivided state highway, which traversed in an east-west direction. The eastbound travel lane was 3.2 m (10.5 ft) in width, while the westbound travel lane was 3.1 m (10.2 ft) in width. The roadway was bordered by 1 m (3.3 ft) wide grass shoulders and ditches approximately 0.6 m (2 ft) in depth. The roadway surface was dry bituminous. The roadway grade was 5.2% in the westbound direction. The speed limit was 89 km/h (55 mph). The Scene Diagram is on page 16 of this report.


**Figure 2:** Approach of the ambulance eastbound to the area of impact, number shows meters to impact area

***Pre-Crash:*** The ambulance was traveling east (**Figure 2**) and had just crested of a hill, which was located 63 m (206.6 ft) west of the impact area. Westbound vehicles were slowing and

stopping to yield to the ambulance as it approached. The Peterbilt was westbound (**Figure 3**) behind these vehicles and the Peterbilt's driver applied lock-wheel braking in an attempt to avoid the vehicle in front of him. The Peterbilt skidded 30 m (98.4 ft) as it rotated counterclockwise approximately 25 degrees to impact in the eastbound lane. The driver of the ambulance initiated a right steering maneuver and applied lock-wheel braking in an attempt to avoid the crash. The vehicle's right side wheels departed the edge of the roadway as it skidded 17 m (55.8 ft) to impact.

**Figure 3:** Approach of the Peterbilt westbound to the area of impact

***Crash:*** The Peterbilt entered the ambulance's travel lane where the front plane of the Peterbilt (**Figure 4**) impacted and overrode the front bumper of the ambulance (**Figure 5**, event 1). The impact occurred 2.6 m (8.5 ft) into the ambulance's travel lane. A witness reported to police that the back end of the ambulance pitched up several feet off the pavement at impact. The WinSMASH program calculated a Barrier Equivalent Speed for (BES) the ambulance of 31 km/h (19.3 mph). Based on the damage to the ambulance, the BES appeared low. The ambulance entered the ditch and traveled approximately 5 m (16 ft) where the right plane impacted the back slope of the ditch (event 2). The vehicle traveled an additional 2 m (6.6 ft) and came to final rest in the ditch heading southeast. The Peterbilt rotated counterclockwise approximately 140 degrees for 11 m (36 ft) and came to rest in the middle of the roadway heading southeast.

**Figure 4:** Police on-scene photo viewed west showing final rest positions of the ambulance and the Peterbilt


**Figure 5:** Damage to the front plane of the ambulance from impact with the front plane of the Peterbilt

***Post-Crash:*** The police were notified of the crash at 1332 hours and arrived on scene at 1343 hours. Emergency medical, including air ambulances and rescue services, also responded to the crash scene. Rescue personnel mechanically opened the left front door of the ambulance and cut the safety belt to extricate the driver from the vehicle. The two PMs and patient were removed through the patient loading doors by emergency responders. The patient was pronounced deceased at the crash scene. The driver and both PMs were transported

by air ambulance to a trauma center. The driver sustained serious injuries and was admitted. The male PM sustained moderate injuries and was admitted. The female PM sustained moderate injuries and was treated in the emergency room and released. The driver of the Peterbilt was transported to a trauma center by air ambulance and admitted.

## 1996 FORD E350 TYPE III AMBULANCE

### DESCRIPTION

The Ford was a rear-wheel drive, 2-passenger, 2-door, E350 RV cutaway (VIN: 1FDKE30FOTHxxxxxx) manufactured in May, 1996. The ambulance was manufactured by Lifeline Emergency Vehicles of Sumner Iowa on January 13, 1997. The patient compartment was refurbished and remounted by Arrow Manufacturing of Rock Rapids, Iowa. The date of the refurbishment is not known. The vehicle was equipped with a 7.3-liter, V-8, turbo -charged, diesel engine, a 4-speed automatic transmission, front disc brakes, and rear drum brakes. The vehicle was not equipped with frontal air bags. The tilt steering column was displaced from the intrusion of the instrument panel and the tilt adjustment of the steering column could not be determined. The patient compartment was configured with a right side entry door, double rear doors for patient loading, and multiple storage cabinets along the left side and front. A class M oxygen cylinder was located under the bench seat on the right side of the patient compartment. The windshield glazing was AS1 laminated. The left front and right front glazing were AS2 tempered. No AS label was present on the right side and backlight glazing of the patient compartment. Prior to the crash, all of the glazing was either closed or fixed.

The vehicle manufacturer's recommended tire size was LT225/75R16 for the front and rear tires. The vehicle was equipped with tires of the recommended size. The recommended cold tire pressure was 448 kPa (65 psi) for the front tires and 414 kPa (60 psi) for the rear tires. The ambulance's tire data are presented in the table below.

| *Position* | *Measured Pressure* | *Measured Tread Depth* | *Restricted* | *Damage* |
|---|---|---|---|---|
| LF | Flat | 8 mm ( 10/32 in) | Yes | Cut sidewall |
| LR Outside | 400 kPa ( 58 psi) | 7 mm ( 9/32 in) | No | None |
| LR Inside | 400 kPa ( 58 psi) | 8 mm ( 10/32 in) | No | None |
| RR Inside | 400 kPa ( 58 psi) | 7 mm ( 9/32 in) | No | None |
| RR Outside | Flat | 7 mm ( 9/32 in) | No | None |
| RF | Flat | 8 mm ( 10/32 in) | No | None |

The front row was equipped with cloth covered, box-mounted seats and integral head restraints. The driver's and front right passenger's seat tracks were adjusted to the rear position and the seat backs were in the upright position. The patient compartment was configured with a vinyl covered, rear-facing, box-mounted seat located behind the driver. A three passenger, vinyl covered, bench seat was located along the right side of patient compartment and a vinyl covered, single seat on the left side of the patient compartment.

**EXTERIOR DAMAGE**

***Exterior Damage Event 1***: The ambulance sustained front plane damage during the impact with the Peterbilt (event1). The front bumper, grille, hood, left head lamp/turn signal assembly, left fender, left front wheel, left A-pillar, and left front door were directly damaged. The direct damage on the front plane began at the front left bumper corner and extended 116 cm (45.7 in) along the front plane. The Field L was 145 cm (57.1 in). The crush measurements were taken at the front bumper level and upper radiator frame level since the vehicle was overridden by the front bumper of the Peterbilt. The maximum residual crush occurred at $C_1$ and was 44 cm (17.3 in) at the bumper level and 87 cm (34.3 in) at the radiator frame level. The crush measurements met the crush averaging protocol and the maximum average crush at $C_1$ was 66 cm (26 in). The averaged crush values were: $C_1$=66 cm (26 in), $C_2$= 47 cm (18.5 in), $C_3$=40 cm (15.7 in), $C_4$= 24 cm (9.4 in), $C_5$= 9 cm (3.5 in), $C_6$= 0 cm. The vehicle's left side wheelbase was reduced 51 cm (20.1 in), while the right side wheelbase was extended 8 cm (3.1 in).

***Damage Classification, Event 1:*** The Collision Deformation Classification (CDC) for the impact with the Peterbilt was 11FYAW6 (340 degrees). The WinSMASH program could not be used to calculate Delta V since an impact with a heavy truck is out of scope for the program. The WinSMASH program was used to calculate a Barrier Equivalent Speed (BES) based on the front crush to the ambulance. The calculated BES was 31 km/h (19.3 mph). The BES value appeared low based on the damage to the vehicle.

***Exterior Damage, Event 2:*** The ambulance sustained damage to the right side of the patient compartment when it impacted the back slope of the ditch. The direct damage began 249 cm (98 in) forward of the right rear axle and extended 209 cm (82.3 in) rearward on the right plane. The Field L was also 209 cm (82.3). The maximum residual crush was 5 cm (2 in) occurring at $C_3$. The crush values were: $C_1$=0 cm, $C_2$= 0 cm, $C_3$=5 cm (2 in), $C_4$= 2 cm (0.8 in), $C_5$= 0 cm, $C_6$= 0 cm.

***Damage Classification, Event 2:*** The CDC was 01RPLW1 (20 degrees). The WinSMASH program could not be used to calculate Delta V for this impact since there are no stiffness coefficients for the patient compartment. The severity of the damage was minor.

**INTERIOR DAMAGE**

The interior of the cab of the ambulance sustained major damage from sixteen intruding components. The most severe intrusions into the driver's space involved the left instrument panel,

steering assembly, and toe pan, which intruded 55 cm (21.6 in), 41 cm (16 in), and 39 cm (15.4 in), respectively.

The inspection of the front row revealed scuff marks on the lower instrument panel on the left and right side of the steering column from contact by the driver's knee. The lower steering wheel rim was scuffed, probably from contact by the driver's chest and abdomen. The steering wheel was probably rotated to the right approximately 90 degrees at the time of the impact due to the driver's right steering avoidance maneuver. The steering wheel rim was not deformed and the hub assembly was displaced and missing. The driver's seat cushion was deformed by intrusion and the seat back was tilted forward slightly. The instrument panel was deformed and displaced.

The left front door was jammed shut and had been mechanically opened during extrication of the driver. The right front door was jammed shut. The windshield was in place and holed by impact forces. The left and right front glazing was disintegrated from impact forces.

The inspection of the patient compartment revealed that the plexiglass door to the rear-facing supply cabinet (**Figure 6**) at the front left of the patient compartment was fractured and the lower right portion of the seat back of the rear-facing seat was dented. The door to the electrical cabinet located behind the rear-facing seat was also separated from the piano hinge. There were scuff marks on the top and upper left side of the supply cabinet (**Figure 7**) located in the front right of the patient compartment. Scuff marks were also present on the header panel above the right side entry door. These were probably related to occupant contact by the male PM who was seated on the bench seat on the right side of the patient compartment. Following the crash, he was found on top of the patient in the stair well for the right side entry door. The front wall of the patient compartment immediately behind the driver's seat was deformed and fractured from crash forces. The M class oxygen cylinder located under the bench seat was undamaged and remained secured in its cradle by three metal securement straps. There was no damage to the visible oxygen lines. The right side entry door and patient loading doors remained closed and operational. The deformation of the metal entry step for the right side entry door prevented the door from opening

**Figure 6:** Overview of front of patient compartment; arrows show cracked plexiglass door and dented seat back from probable contact by the PM who was seated on the bench seat on the right side of the patient compartment

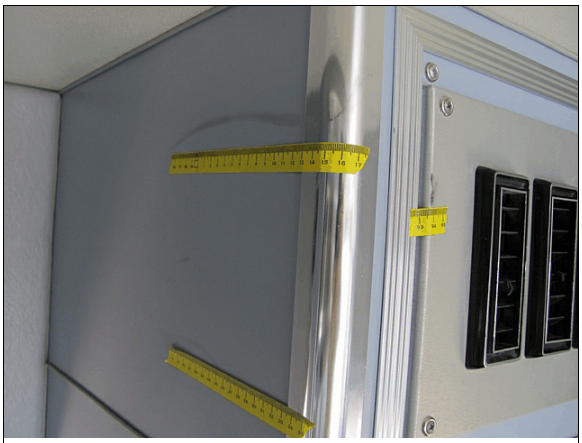


**Figure 7:** Scuff marks on top of the supply cabinet located in the front right corner of the patient compartment

more than approximately 8 cm (3 in). There were no intrusions of the patient compartment.

***Patient Cot:*** The cot that was used to transport the patient was a Ferno 93ES Squadmate (**Figure 8**). The identification label was partially worn off the cot and no serial number was located. The cot's mattress was not present at the SCI inspection. The cot was an aluminum H-frame design with swing-down side rails and was adjustable to four height positions. The backrest had eight adjustments that allowed for a range of backrest angles from 0-75 degrees. The inner height adjustment tube was completely fractured at the 6th detent from the bottom (**Figure 9**). The approximate backrest adjustment angle was 47 degrees. The inner adjustment tube was 18 mm (0.7 in) in diameter (**Figure 10**) and the wall thickness of the tube was 3 mm (0.1 in). The outer tube was 33 mm (1.3 in) in diameter and the wall thickness of the tube was 3 mm (0.1 in). The cot was equipped with shoulder/upper torso restraints, lower torso restraints, and leg restraint, all of which were tied to the frame of the cot. The upper and lower torso restraints were buckled and each belt webbing had been cut.

**Figure 8:** The Ferno 93ES Squadmate patient cot

**Figure 9:** The fractured inner height adjustment tube for the patient cot backrest

The cot was reported by the operations director to have been secured by the antler bracket and rail clamp. The antler bracket secures the head of the cot by restraining the undercarriage using the wheel frames as anchor points. The rail clamp secured the frame of the cot. The cot was displaced out of its anchors during the crash and came to final rest against the front of the bench seat. The rail clamp was not damaged. The antler clamp was not present. It was reported by the operations director to have been removed during the extrication of the patient.

## MANUAL RESTRAINT SYSTEMS

The front row was equipped with driver and front right passenger lap-and-shoulder safety belts. The driver's safety belt was equipped with continuous loop belt webbing, a sliding latch plate, a fixed upper anchor and an Emergency Locking Retractor (ELR). The front right safety

belt was equipped with continuous loop belt webbing, a sliding latch plate, a fixed upper anchor, and a switchable ELR/Automatic Locking Retractor (ALR). Neither safety belt was equipped with a pretensioner.

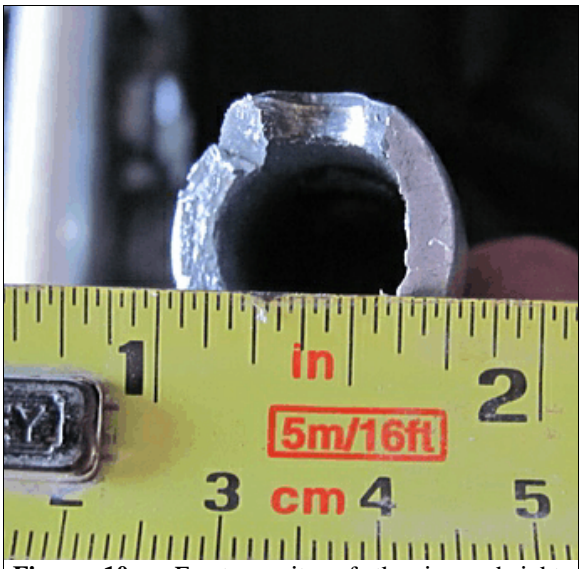



**Figure 10:** Fracture site of the inner height adjustment tube for the patient cot backrest

Inspection of the driver's safety belt assembly revealed that the webbing had been cut and was drawn into the retractor. This evidence indicated that the driver was restrained at the time of the crash and rescue personnel had cut the belt webbing to extricate the driver from the vehicle.

In the patient compartment, the rear-facing seat was equipped with a lap belt with a sewn latch plate and an ALR. There were three lap safety belts on the bench seat equipped with ALRs and sewn latch plates. The single seat on the left side of the patient compartment was also equipped with a lap safety belt with an ALR and sewn latch plate. Three safety belt buckles were located on the vertical front surface of the box on which the bench seat was mounted. They were for securing a patient in the supine position on the bench seat.

The female PM was seated in the single seat on the left side of the patient compartment. Inspection of the lap safety belt revealed no evidence of usage. The female PM told the police reconstruction officer that she was not restrained. The male PM was also not restrained at the time of the crash.

### SUPPLEMENTAL RESTRAINT SYSTEMS

The ambulance was not equipped with frontal air bags.

## 1996 FORD E350 TYPE II AMBULANCE OCCUPANTS

### DRIVER DEMOGRAPHICS

| | |
|---|---|
| Age/Sex: | 48 years/male |
| Height: | 191 cm (75 in) |
| Weight: | 104 kg (230 lb) |
| Eyewear: | Unknown |
| Seat Type: | Box-mounted bucket seat |
| Seat Track Position: | Rear position |
| Restraint Usage: | Lap-and-shoulder belt |
| Usage Source: | Vehicle inspection |

Air Bags No equipped
Alcohol/Drug Involvement: Police reported none
Egress from Vehicle: Extricated by emergency responders through left front door
Transport from Scene: Air ambulance to trauma center
Medical Treatment: Hospitalized four days

**DRIVER INJURIES**

| Injury Number | Injury | AIS 2005/08 | Injury Source | Confidence Level |
|---|---|---|---|---|
| 1 | Concussion with loss of consciousness of unknown duration; patient had some disorientation initially but does remember the events of the crash | 161002.2,0 | A-pillar, left | Probable |
| 2 | Laceration, full thickness, 1 cm (0.4 in) to thyroid cartilage, not further specified | 340208.3,4 | Left instrument panel | Probable |
| 3 | Fractured ribs: right 5th through 8th, anteriorly, and left 7th rib, anteriorly | 450203.3,3 | Steering wheel hub and/or spokes and rim | Probable |
| 4 | Pneumothorax, tiny, right, nonsignificant, not further specified | 442202.2,1 | Steering wheel hub and/or spokes | Probable |
| 5 | Laceration (intrasubstance tear) liver, grade 1; no hematoma present; not further specified[1] | 541822.2,1 | Steering wheel hub and/or spokes and rim | Probable |
| 6 | Laceration (intrasubstance tear) spleen, grade 1; no hematoma present, not further specified[2] | 544222.2,2 | Steering wheel hub and/or spokes and rim | Probable |
| 7 | Contusion (and/or traumatic pancreatitis), small, but no fracture, not further specified | 542810.2,7 | Steering wheel hub and/or spokes and rim | Probable |
| 8 | Fracture, open[3], left olecranal tip, with surgical ORIF required, not further specified | 752113.2,2 | Left front door panel, forward upper quadrant | Probable |
| 9 | Dislocation, open, left elbow joint requiring surgical repair to lateral collateral ligament complex | 772031.1,2 | Left front door panel, forward upper quadrant | Probable |

[1] A small intraperitoneal hemorrhage was present.

[2] A free fluid (blood) collection was present in the left inguinal canal.

[3] There were two, 1 cm (0.4 in) lacerations over the posterior elbow; ORIF means Open Reduction and Internal Fixation.

| Injury Number | Injury | AIS 2005/08 | Injury Source | Confidence Level |
|---|---|---|---|---|
| 10 | Degloving laceration[4], full thickness, 18 cm (7.1 in), left forearm, dorsal surface from wrist to elbow with exposure of tendons and foreign material in or around wound | 714002.2,2 | Left front door panel, forward upper quadrant | Probable |
| 11 | Avulsion, partial, of left triceps muscle, not further specified | 740401.1,2 | Left front door panel, forward upper quadrant | Probable |
| 12 | Laceration extensor forearm muscles: digitorum communis and indicis proprius, requiring surgical repair | 740400.1,2 | Left front door panel, forward upper quadrant | Probable |
| 13 | Fracture left ulnar styloid process, not further specified | 752353.2,2 | Left front door panel, forward upper quadrant | Probable |
| 14 | Fractures pelvis, non-displaced, involving right superior and inferior pubic rami and the left iliac bone extending from posterior surface of acetabulum to sacroiliac joint | 856151.2,4 | Left lower instrument panel (includes knee bolster) (indirect injury) | Probable |
| 15 | Sprain, severe, right ankle–swollen both medially and laterally over deltoid and lateral ligaments | 877110.1,1 | Floor, foot controls | Probable |
| 16 | Contusion (hematoma) left occipital area, not further specified | 110402.1,6 | A-pillar, left | Probable |
| 17 | Laceration, 2 cm (0.8 in), left posterior parietal scalp | 110602.1,2 | A-pillar, left | Probable |
| 18 | Contusion forehead, not further specified | 210402.1,7 | A-pillar, left | Probable |
| 19 | Contusion left cheek, not further specified | 210402.1,2 | A-pillar, left | Probable |
| 20 | Contusion right cheek, not further specified | 210402.1,1 | Steering wheel rim | Possible |
| 21 | Laceration, punctate, 0.5 cm (0.2 in) under chin, not further specified | 310602.1,5 | Left instrument panel | Probable |
| 22 | Abrasions, vertical, mid-lower anterior thorax, not further specified | 410202.1,8 | Torso portion of safety belt system | Probable |
| 23 | Contusions, bilateral chest area, not further specified | 410402.1,3 | Steering wheel hub and/or spokes and rim | Probable |
| 24 | Contusions (soft tissue injury markings) right and left lower abdominal quadrants | 510402.1,8 | Lap portion of safety belt system | Probable |

[4] Excisional debridement, 25 cm (9.8 in), including skin, subcutaneous tissue, and muscle to left forearm were required.

| Injury Number | Injury | AIS 2005/08 | Injury Source | Confidence Level |
|---|---|---|---|---|
| 25 | Laceration, 2 cm (0.8 in), to left lateral knee, angled distally, without joint penetration (confirmed in the operating room) | 810602.1,2 | Left lower instrument panel (includes knee bolster) | Probable |

*Sources: Emergency Room Records, Hospitalization Records, and EMS treatment Record. Injury Numbers 22 and 24 came from **EMS treatment Record**, Injury Numbers 2, 13, 16-20, and 23 came from **Emergency Room Records**, and Injury Numbers 7, 11, 12, and 15 came from **Hospitalization Records**. Injury Numbers 3-6, 9, 14, 21, and 25 came from a combination of **Emergency Room** and **Hospitalization Records**, and Injury Numbers 1, 8, and 10 came from all records sources.*

## DRIVER KINEMATICS

The restrained driver steered right and applied lock wheel braking just prior to the impact. He was displaced forward into the safety belt and the retractor locked as the vehicle skidded to impact. The impact with the Peterbilt redirected the driver forward and to the left opposite the 11 o'clock direction of force. His knees contacted the intruding lower instrument panel, which fractured his pelvis. The driver's chest and abdomen contacted the lower portion of the intruded steering wheel, which was at the approximate 9 o'clock position from the right steering maneuver and caused fractures of the right 5th through 8th and left 7th ribs, pneumothorax, lacerated liver, lacerated spleen, and a contusion of the pancreas. The driver's throat contacted the top edge of the intruded and fractured instrument panel, which caused a laceration to the thyroid cartilage. His head contacted the intruding left A-pillar causing a concussion with loss of consciousness. The driver's left arm contacted the intruding left front door, which caused an open fracture of the olecranal tip, open dislocation of the left elbow joint, degloving laceration of the left forearm, avulsion of left triceps, laceration of left forearm extensor muscles, and a fracture of the ulnar styloid process. The driver also sustained multiple contusions, abrasions, and lacerations. Rescue personnel mechanically opened the left front door and cut the safety belt to extricate the driver through the left front door. He was transported by air ambulance to a trauma center where he was hospitalized for four days and then transferred to a rehabilitation facility.

## OTHER ROW PASSENGER, BENCH SEAT, PARAMEDIC DEMOGRAPHICS

| | |
|---|---|
| Age/Sex: | 35 years/male |
| Height: | Unknown |
| Weight: | 82 kg (181 lbs) |
| Eyewear: | Unknown |
| Seat Type: | Front seating position on bench seat on right side of patient compartment |
| Seat Track Position: | N/A |
| Restraint Usage: | None |
| Usage Source: | Interview with director of ambulance operations |
| Air Bags | None available |

Alcohol/Drug Involvement: None
Egress from Vehicle: Removed by emergency responders through patient loading doors
Transport from Scene: Air ambulance to trauma center
Medical Treatment: Hospitalized eight days

**OTHER ROW PASSENGER, BENCH SEAT, PARAMEDIC INJURIES**

| Injury Number | Injury | AIS 2005/08 | Injury Source | Confidence Level |
|---|---|---|---|---|
| 1 | Fracture, comminuted, 3-part, left proximal humerus through surgical neck with separate greater tuberosity fragment retracted beneath acromion and substantial shaft displacement lateral to humeral head | 751161.2,2 | Other interior object: ambulance medical supply cabinet at the front left of the patient compartment | Probable |
| 2<br>3 | Fracture of right lateral tibial plateau with minimal/mild depression and non-displaced fractures of posterior medial tibial plateau and head of fibula with high-grade partial tear of medial collateral ligament | 854171.2,1<br>854471.2,1 | Other interior object: seat back of rear-facing seat in front left of patient compartment | Probable |
| 4 | Sprain (lipohemarthrosis[5], large), low grade, right knee with edema and effusion | 874010.1,1 | Other interior object: seat back of rear-facing seat in front left of patient compartment | Probable |
| 5 | Bruising about left proximal humerus, not further specified | 710402.1,2 | Other interior object: ambulance medical supply cabinet at the front left of the patient compartment | Probable |

*Source(s): Emergency Room Records, Hospitalization Records, and EMS treatment Record. Injury Number 5 came from **Emergency Room Records**, Injury Numbers 2 through 4 came from **Hospitalization Records**. Injury Number 1 came from a combination of **Emergency Room** and **Hospitalization Records**.*

**OTHER ROW PASSENGER, BENCH SEAT, PARAMEDIC KINEMATICS**

The unrestrained PM was seated in the front seating position of the bench seat located on the right side of the patient compartment. He had just moved from the rear-facing seat to the bench seat when the crash occurred. The PM was probably displaced forward when the driver steered right and applied the brakes. The impact with the Peterbilt redirected the PM forward and

[5] The following term is defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:
***lipohemarthrosis (lip"o-hem"ahr-thro'sis)***: the presence of fat-containing blood in a joint, with intra-articular fracture.
Simply put, lipohemarthrosis is the mixture of fat and blood in a joint cavity following trauma. The fat and blood enter the joint from the marrow space through an osteochondral defect at the articular surface of the joint. As fat is less dense than blood, it floats on the surface of the blood collection. With horizontal beam radiography, a fat-fluid level is detected due to differences in attenuation of these two substances. http://www.gentili.net/FBI/

to the left opposite the 11 o'clock direction of force. He probably contacted the rear-facing seat and the supply cabinet at the front left of the patient compartment, which fractured the cabinet's plexiglass door. The contact with the supply cabinet caused a comminuted fracture of the left humerus. The contact with the rear-facing seat fractured the right fibula and tibia and sprained the right knee. The PM rebounded and was redirected to the right and contacted the supply cabinet located at the front right of the patient compartment as the right side of the ambulance impacted the embankment. He came to final rest on top of the patient in the step well for the right side entry door. The PM was removed from the patient compartment by emergency responders through the patient loading doors. He was transported by air ambulance to a trauma center where he was hospitalized for eight days.

**OTHER ROW PASSENGER, LEFT SIDE SINGLE SEAT, PARAMEDIC DEMOGRAPHICS**

| | |
|---|---|
| Age/Sex: | 47 years/female |
| Height: | 168 cm (66 in) |
| Weight: | 89 kg (196 lbs) |
| Eyewear: | Unknown |
| Seat Type: | Inward-facing single seat on left side of patient compartment |
| Seat Track Position: | Fixed |
| Restraint Usage: | None |
| Usage Source: | Vehicle inspection, police reconstruction report |
| Air Bags | None available |
| Alcohol/Drug Involvement: | None reported |
| Egress from Vehicle: | Removed by emergency responders through patient loading doors |
| Transport from Scene: | Air ambulance to trauma center |
| Medical Treatment: | Treated in emergency room and released |

**OTHER ROW PASSENGER, LEFT SIDE SINGLE SEAT, PARAMEDIC INJURIES**

| Injury Number | Injury | AIS 2005/08 | Injury Source | Confidence Level |
|---|---|---|---|---|
| 1 | Fracture (punch) left tibia, not further specified | 854000.2,2 | Other interior object: box mount for the rear-facing seat in front left of patient compartment | Probable |
| 2<br>3 | Laceration (tear), partial, anterior cruciate ligament and & medial[6] collateral ligament of left knee | 840501.2,2<br>840406.2,2 | Other interior object: box mount for the rear-facing seat in front left of patient compartment | Probable |
| 4 | Contusion (injury soft tissue), large, right hip, not further specified | 510402.1,1 | Other interior object: ambulance patient cot | Possible |

[6] The police reconstruction report actually said NCL, which this contractor interpreted as MCL.

| Injury Number | Injury | AIS 2005/08 | Injury Source | Confi-dence Level |
|---|---|---|---|---|
| 5 | Contusions, multiple, not further specified | 910400.1,0 | Unknown injury source | Unknown |

*Source(s): Emergency Room Records and Police Reconstruction Report. Injury Numbers 1 through 3 and 5 came from the **Police Reconstruction Report**. Injury Number 4 came from a combination of the **ER Report** and the **Police Reconstruction Report**.*

## OTHER ROW PASSENGER, LEFT SIDE SINGLE SEAT, PARAMEDIC KINEMATICS

The unrestrained PM was seated in the left side single seat monitoring the patient when the crash occurred. The impact with the Peterbilt displaced the PM forward out of her seat and she contacted her left leg on the box mount for the rear-facing seat, which fractured the left tibia and caused tears to the left cruciate ligament and medial collateral ligaments of the left knee. She also contacted the patient cot with her right hip, which caused a contusion to the hip. The impact with the back slope of the ditch redirected the PM to the right and forward and she came to final rest in the front right area of the patient compartment. She was removed from the patient compartment by emergency responders through the patient loading doors. The PM was transported by air ambulance to a trauma center where she was treated in the emergency room and released.

## OTHER ROW PASSENGER, PATIENT DEMOGRAPHICS

| | |
|---|---|
| Age/Sex: | 67 years/male |
| Height: | Unknown |
| Weight: | 104 kg (230 lbs) |
| Eyewear: | Unknown |
| Seat Type: | Patient cot |
| Seat Track Position: | N/A |
| Restraint Usage: | Upper and lower torso and leg restraints |
| Usage Source: | Vehicle inspection, police reconstruction report |
| Air Bags | None available |
| Alcohol/Drug Involvement: | None |
| Egress from Vehicle: | Removed by emergency responders |
| Transport from Scene: | Pronounced deceased at scene and taken to local mortuary |
| Medical Treatment: | None |

## OTHER ROW PASSENGER, PATIENT INJURIES

The nature and extent of the patient's injuries were not determined since no autopsy was performed.

The patient was restrained in the supine position on the patient cot facing rearward. The backrest angle was approximately 47 degrees. The patient was receiving oxygen and was on a cardiac monitor. The patient was restrained by the upper and lower torso and leg restraints, but the shoulder restraints were not in use. The impact with the Peterbilt displaced the patient forward into the cot's backrest, which completely fractured the backrest's inner height adjustment tube and the backrest collapsed. The patient was displaced forward out from under the restraints and off the cot. He probably contacted front of the patient compartment. The patient was redirected to the right during the crash and came to final rest in the step well for the right side entry door. The male PM came to final rest on top of the patient. The cot was displaced out of its anchors during the crash and came to final rest against the front of the bench seat. The patient was pronounced deceased by the county coroner 5 minutes following the crash. He was transported from the crash scene to a local mortuary. There was no documentation of the injuries sustained by the patient since no autopsy was conducted.

## 1995 PETERBILT 378

### DESCRIPTION

The Peterbilt was a 6x4, rear wheel drive, 2-passenger, 2-door truck-tractor with a dump truck body (VIN: 1XPFDE8X1SNxxxxxx), equipped with a Caterpillar 3176, 10.3-liter, I-6 diesel engine, standard 9-speed manual transmission, and dual air brakes.

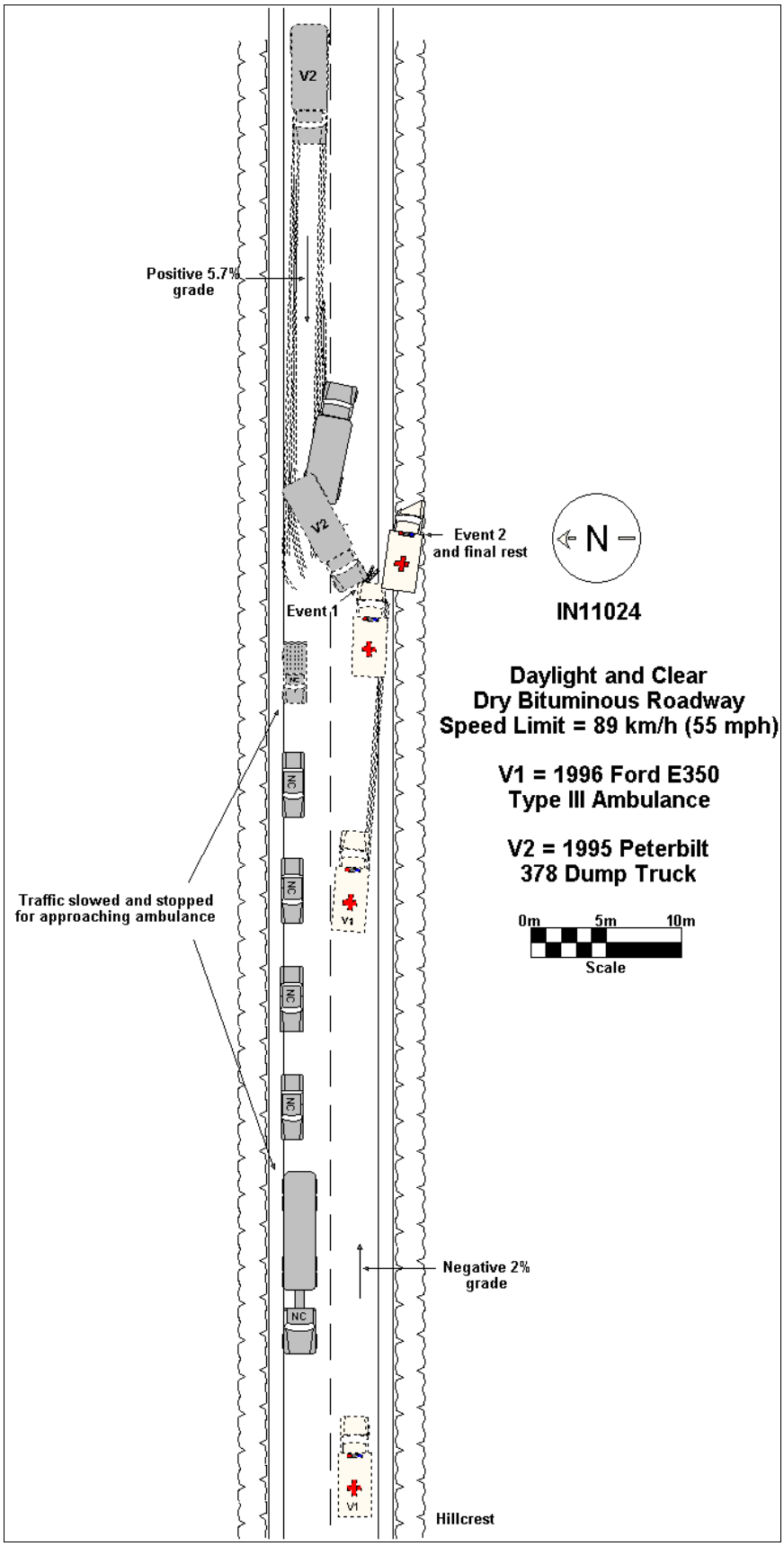
### EXTERIOR DAMAGE

The Peterbilt sustained direct damage to the front bumper, grille, right fender, and right headlamp assembly.

***Damage Classification:*** The Truck Deformation Classification (TDC) was 12FDEW1 (350 degrees).

### OCCUPANT DATA

The driver of the Peterbilt (74-year-old male) was not restrained by the lap-and-shoulder safety belt. He was partially ejected through the right front window. The driver sustained a police reported "B" (non-incapacitating) injury and was transported by air ambulance to a trauma center where he was admitted.


V2
Positive 5.7% grade
V2
Event 2 and final rest
N
Event 1
IN11024
Daylight and Clear
Dry Bituminous Roadway
Speed Limit = 89 km/h (55 mph)
V1 = 1996 Ford E350
Type III Ambulance
V2 = 1995 Peterbilt
378 Dump Truck
0m 5m 10m
Scale
Traffic slowed and stopped for approaching ambulance
NC
NC
V1
NC
NC
Negative 2% grade
V1
Hillcrest